



02/17/00

UTILITY PATENT APPLICATION TRANSMITTAL

Address to: Box PATENT APPLICATION Assistant Commissioner for Patents Washington, DC 20231	Attorney Docket No.	LUTA 0252 PUS
	Inventor(s) or Application Identifier: QUINGFENG TANG	

jc511 U.S. PTO
09/506043

1. This application entitled TUNELESS NARROW-BAND SUPPER-REGENERATIVE RECEIVER is:
- a. ☒ A new application under 37 C.F.R. §1.53(b).
- b. ☐ A ☐ continuation ☐ divisional or ☐ continuation-in-part application under 37 C.F.R. § 1.53(b) of prior application Serial No. filed on , entitled .

Application elements and other attached papers:

2. ☒ Specification (incl. Claims and Abstract) [Total Pages 6]
3. ☒ Drawings (☒ informal ☐ formal) [Total Sheets 1]
4. ☒ Oath or Declaration
- a. ☒ Newly-executed
- b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))
5. ☐ Incorporation By Reference: The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Item 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ This application is filed by fewer than all the inventors named in the prior application, 37 C.F.R. § 1.53(d)(4).
- a. ☐ **DELETE** the following inventor(s) named in the prior nonprovisional application:

- b. ☐ The inventor(s) to be deleted are set forth on a separate sheet attached hereto.

CERTIFICATION UNDER 37 C.F.R. § 1.10

I hereby certify that this UTILITY PATENT APPLICATION TRANSMITTAL and the documents referred to as attached therein are being deposited on the below date with the United States Postal Service in an envelope as "Express Mail Post Office to Addressee" addressed to: Box Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

Express

Mail Label No. EL503257256USLORRAINE SCHNEIDER

(Type or print name of person mailing paper)

Date of Deposit: February 17, 2000Lorraine Schneider
(Signature of person mailing paper)

7. Preliminary Amendment:

- a. ☐ A Preliminary Amendment is attached.
- b. ☐ Cancel in this application original claims _____ of the prior application before calculating the filing fee.
- c. ☐ Please amend the specification by inserting before the first line the sentence:
- "This is a
- ☐ continuation
- ☐ divisional
- of copending application(s)
- Serial number _____ / _____ filed on _____."
- d. ☐ A Petition to Suspend Prosecution For The Time Necessary to File An Amendment (New Application Filed Concurrently) is attached.

8. Small entity status:

- a. ☐ A small entity statement is attached.
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer desired.

9. Fee Calculation:

FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS (37 C.F.R. § 1.16(c))	6 -20 =	0	X 18.00	0
INDEPENDENT CLAIMS (37 C.F.R. § 1.16(b))	1 -3 =	0	X 78.00	0
MULTIPLE DEPENDENT CLAIMS (if applicable) (37 C.F.R. § 1.16(d))			260.00	
			BASIC FEE (37 C.F.R. § 1.16(a))	690.00
Total of above Calculations =				\$690.00
Reduction by 50% for filing by small entity (Note 37 C.F.R. §§ 1.9, 1.27, 1.28)				
Assignment Recordal Fee			40.00	\$40.00
TOTAL =				\$730.00

10. ☒ A check in the amount of \$ 730.00 is enclosed.

11. ☒ The Commissioner is hereby authorized to credit overpayments or charge the following fees (or any deficiency therein) to Deposit Account No. 02-3978:

- a. ☒ Fees required under 37 C.F.R. § 1.16.
- b. ☒ Fees required under 37 C.F.R. § 1.17.

12. Maintenance of Copendency of Prior Application

☐ A request for extension of time and the appropriate fee have been filed in the pending **prior** application (or are being filed in the prior application concurrently herewith) to extend the period for response until _____.

13. ☐ An Information Disclosure Statement (IDS) is attached, along with the following indicated attachments thereto:

a. ☐ Form PTO/SB/08 (_____ sheet(s))

b. ☐ Copies of references cited

14. ☐ Certified copy of priority document(s)

15. ☒ Return Receipt Postcard

16. ☐ Other: _____

17. ☒ An Assignment of the invention to Lear Corporation

a. ☒ is attached.

b. ☐ was recorded on _____ at Reel _____, Frame _____.

18. The power of attorney in the prior application is to:

Name of Attorney of Record Reg. No.

☐ The power appears in the original papers in the prior application.

☐ The power does not appear in the original papers, but was filed on _____.


☒ A new power has been executed and is attached.

19. Correspondence Address: Please address all future communications to:

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Respectfully submitted,

Date February 17, 2000



Name: Ralph E. Smith
Registration No.: 35,474

☒ Attorney or agent of record

Filed under Rule 34(a)

TUNELESS NARROW-BAND SUPER-REGENERATIVE RECEIVER

TECHNICAL FIELD

5 The present invention generally relates to radio frequency (RF) receivers, and more particularly to an improved super-regenerative receiver arrangement capable of receiving narrow-band signals.

BACKGROUND ART

10 Currently, super-regenerative type receivers are used in connection with wireless/RF security and remote control systems such as vehicle remote keyless entry (RKE) systems because of the low cost of manufacture. Generally, a super-regenerative receiver operates using an oscillating signal detector having the oscillation interrupted, i.e., "quenched," at a relatively low frequency. However, because the quenching operation and frequency force the detector response to be very broad, super-regenerative receivers suffer from the need to use "tuned" input circuits to allow them to be used with narrow-band signals. While such tuned input circuits
15 improve detector response, such receivers still suffer from generally poor selectivity (wide band) characteristics in addition to the added expense of the tuned input circuits.

20 As a result, a need exists for a super-regenerative receiver capable of operating satisfactorily in narrow-band applications.

DISCLOSURE OF INVENTION

It is therefore an object of the present invention to provide a super-regenerative receiver which can operate with a narrowband without requiring a tuned input circuit.

25 It is another object of the present invention to provide a cost effective super-regenerative receiver that can operate in a narrow-band application.

It is yet another object of the present invention to provide a super-regenerative receiver that can detect AM (ASK) signals and FM or FSK signals without adding a frequency discriminator.

5 In accordance with these and other objects, the present invention provides a narrow bandwidth, super-regenerative receiver that includes a signal detector having a regenerative oscillator for detecting a signal transmitted at a particular transmit frequency, a quench circuit connected to the regenerative oscillator for interrupting the oscillation of the oscillator at a predetermined frequency, and a frequency sweeping circuit connected to the regenerative oscillator and the quench circuit. The quench circuit is arranged to cycle the regenerative oscillator and the frequency sweeping circuit on and off together, and the frequency sweeping circuit controls operation of the regenerative oscillator to a desired narrow bandwidth around the transmit frequency.

15 With the present invention, a super-regenerative receiver arrangement is advantageously provided that does not require any tuned input circuits, and can demodulate AM (amplitude shift keying (ASK)) as well as FM (frequency shift keying (FSK)) signals using the same receiver detector. The present invention utilizes a quench controlled frequency sweeping circuit to allow the receiver to automatically shift about a particular frequency of an associated transmitter to improve overall sensitivity and tolerance of transmitter frequency variation. Further, wide band noise is significantly reduced.

These and other advantages of the present invention will become apparent to one of ordinary skill in the art in light of the following description and attached drawings.

25

BRIEF DESCRIPTION OF DRAWINGS

The FIGURE is a block circuit diagram of a tuneless narrow-band super-regenerative receiver in accordance with the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The Figure provides a block diagram for an improved super-regenerative receiver 10 in accordance with the present invention. As shown, a regenerative oscillator 12 is arranged to receive a transmitted signal 14 such as via an antenna (not shown). A frequency sweeping circuit 16 provides an input to the regenerative oscillator via an inductor-capacitor network 18 to control the bandwidth at which the receiver can receive a signal. The inductor-capacitance network establishes the sweep bandwidth, and is preferably arranged to provide a narrow-band. The frequency sweeping circuit can be implemented using a low cost surfaced acoustic wave resonator (SAWR), ceramic resonator or LC resonator.

The frequency f_c of the regenerative oscillator is interrupted by a quench control circuit 20. The quench control circuit also controls the frequency f_s of frequency sweeping circuit 16. In operation, quench control circuit 20 cycles both the regenerative oscillator and the frequency sweeping circuit 12 to "turn on" at the same time. The frequency sweeping circuit causes receiver 10 to sweep across a predetermined frequency band defined to cover a desired transmitter frequency. An output signal 22 of the receiver will then approach a maximum signal amplitude when the center frequency is equal to transmitter frequency.

In accordance with the present invention, for a center frequency f_c , sweep frequency f_s , quench frequency f_q , data rate (for digital modulation) or a maximum base band frequency (for analog modulation) f_d , and sweep frequency bandwidth BW_s , the following design characteristics must be met:

$$\begin{aligned} BW_s &= 1-3 \% f_c, \\ f_s &= f_q, \\ f_s &> 2 f_d, \text{ and preferably } f_s = 10 f_d; \text{ and} \\ f_c &>> f_s \text{ or } f_q. \end{aligned}$$

In operation, the frequency sweep circuit forces the regenerative oscillator to function as a center frequency movable bandpass filter. The receiver

will thus automatically tune to the actual transmitter frequency f_{tx} to provide the best reception. The filter bandwidth can thus be very narrow because the impact of variation in the transmitter frequency, such as caused by variations in temperature, is minimized.

5 Thus, the present invention advantageously provides a tuneless narrow band super-regenerative receiver without adding cost. The receiver operates as an amplitude detector, as well as a frequency or phase detector. In other words, the receiver of the present invention can detect AM (ASK) signals and FM or FSK signals without adding a frequency discriminator. In addition, the design lends itself
10 to integration into a single circuit chip, thereby further enhancing use of the receiver in a RKE system.

 While embodiments of the invention have been illustrated and described, it is not intended that these embodiments illustrate and describe all possible forms of the invention. Rather, the words used in the specification are
15 words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1 1. A narrow bandwidth, super-regenerative receiver comprising:
2 a signal detector having a regenerative oscillator for detecting a signal
3 transmitted at a particular transmit frequency;
4 a quench circuit connected to the regenerative oscillator for
5 interrupting the oscillation of the oscillator at a predetermined frequency; and
6 a frequency sweeping circuit connected to the regenerative oscillator
7 and the quench circuit, wherein the quench circuit is arranged to cycle the
8 regenerative oscillator and the frequency sweeping circuit on and off together, and
9 the frequency sweeping circuit controls operation of the regenerative oscillator to a
10 desired narrow bandwidth around the transmit frequency.

1 2. The receiver of claim 1 further comprising: for a center
2 frequency f_c , a sweep frequency f_s , a quench frequency f_q , a data rate or a maximum
3 base band frequency of the transmitted signal f_d , and a sweep frequency bandwidth
4 BW_s , the following design characteristics:
5 $BW_s = 1-3 \% f_c$;
6 $f_s = f_q$;
7 $f_s > 2 f_d$; and
8 $f_c >> f_s$ or f_q

1 3. The receiver of claim 2 wherein $f_s = 10f_d$.

1 4. The receiver of claim 1 wherein the frequency sweeping circuit
2 comprises a surfaced acoustic wave resonator.

1 5. The receiver of claim 1 wherein the frequency sweeping circuit
2 comprises a ceramic resonator.

1 6. The receiver of claim 1 wherein the frequency sweeping circuit
2 comprises an LC resonator.

ABSTRACT OF THE DISCLOSURE

5 A super-regenerative receiver is provided with a regenerative oscillator controlled by a frequency sweep circuit to control the bandwidth at which the receiver can receive a signal. A quench control circuit controls both the regenerative oscillator and the frequency sweeping circuit to "turn on" at the same time. The frequency sweep circuit forces the regenerative oscillator to function as a center frequency movable bandpass filter allowing the receiver to automatically
10 tune to the actual transmitter frequency f_{tx} to provide the best reception. This allows the receiver/filter bandwidth to be very narrow. The receiver operates as an amplitude detector, as well as a frequency or phase detector, thereby allowing the same receiver to detect AM (ASK) signals and FM or FSK signals without adding a frequency discriminator.

DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

Atty. Docket No. LUTA 0252 PUS
First Named Inventor Qingfeng Tang

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TUNELESS NARROW-BAND SUPPER-REGENERATIVE RECEIVER,

the specification of which:

☒ is attached hereto; or
☐ was filed on (MM/DD/YYYY) _____ as U.S. Application Number or PCT International Application Number _____, and was amended on (MM/DD/YYYY) ____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

<i>Prior Foreign Application Number(s)</i>	<i>Country</i>	<i>Foreign Priority Date (MM/DD/YYYY)</i>	<i>Priority Not Claimed</i>	<i>Certified Copy Attached? (Yes/No)</i>

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

<i>Application Number(s)</i>	<i>Filing Date (MM/DD/YYYY)</i>

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

<i>Application Number(s)</i>	<i>Filing Date (MM/DD/YYYY)</i>	<i>Status: Patented, Pending, Abandoned</i>

Declaration for Patent Application (cont'd.)Atty. Docket No. LUTA 0252 PUS

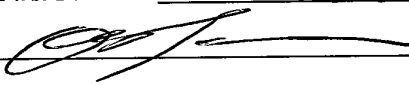
I hereby appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Ernie L. Brooks, Reg. No. 26,260; James A. Kushman, Reg. No. 25,634; David R. Syrowik, Reg. No. 27,956; Mark A. Cantor, Reg. No. 30,614; Ralph M. Burton, Reg. No. 17,748; Robert C.J. Tuttle, Reg. No. 27,962; Earl J. LaFontaine, Reg. No. 30,766; Ronald M. Nabozny, Reg. No. 28,648; Thomas A. Lewry, Reg. No. 30,770; John E. Nemazi, Reg. No. 30,876; Kevin J. Heintz, Reg. No. 29,805; William G. Abbott, Reg. No. 31,936; Donald J. Harrington, Reg. No. 17,427; Timothy G. Newman, Reg. No. 34,228; Frederick M. Ritchie, Reg. No. 18,669; Robert C. Brandenburg, Reg. No. 29,048; A. Frank Duke, Reg. No. 20,937; John M. Halan, Reg. No. 35,534; Jeffrey M. Szuma, Reg. No. 35,700; James R. Ignatowski, Reg. No. 26,741; Frank A. Angileri, Reg. No. 36,733; William G. Conger, Reg. No. 31,209; Sangeeta G. Shah, Reg. No. 38,614; Christopher W. Quinn, Reg. No. 38,274; Robert C. Jones, Reg. No. 35,209; David S. Bir, Reg. No. 38,383; Konstantine J. Diamond, Reg. No. 39,657; James N. Kallis, Reg. No. 41,102; Hugo A. Delevie, Reg. No. 32,688; Ralph E. Smith, Reg. No. 35,474; Michael S. Brodbine, Reg. No. 38,392; Jeremy J. Curcuri, Reg. No. 42,454; Mark D. Chuey, Reg. No. 42,415; and John J. Ignatowski, Reg. No. 36,555; Pete N. Kioussis, Reg. No. 41,117; Gigette M. Bejin, Reg. No. 44,027; Stephanie M. Mansfield, Reg. No. 43,773; Mark E. Stuenkel, Reg. No. 44,364; Matthew R. Mowers, Reg. No. 44,956; Raymond J. Vivacqua, Reg. No. 45,369; Lawrence G. Almeda, Reg. No. P-46,151; Ginta Kukainis, Reg. No. P-46,082; Seth E. Rodack, Reg. No. P-45,622.

Address all correspondence and telephone calls to Ralph E. Smith
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor Qingfeng Tang

Inventor's signature  Date 2/14/00

Post Office Address 37704 Baywood Drive, Farmington Hills, MI 48335

Residence (Same as Above) Citizenship China